

# Notice of Allowability

Application No.

10/806,649

Examiner

George Nguyen

Applicant(s)

ZUNIGA ET AL.

Art Unit

3723

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☐ This communication is responsive to \_\_\_\_.
2. ☒ The allowed claim(s) is/are 1-8.
3. ☒ The drawings filed on 22 March 2004 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
  - a) ☐ All b) ☐ Some\* c) ☐ None of the:
    1. ☐ Certified copies of the priority documents have been received.
    2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
    3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_.

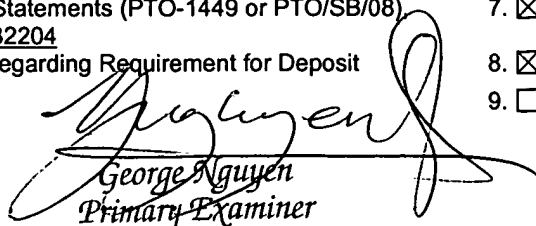
Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
  6. ☐ CORRECTED DRAWINGS ( as "replacement sheets") must be submitted.
    - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review ( PTO-948) attached
      - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date \_\_\_\_.
    - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

## Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08)  
Paper No./Mail Date 032204
4. ☐ Examiner's Comment Regarding Requirement for Deposit  
of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413),  
Paper No./Mail Date \_\_\_\_.
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other \_\_\_\_.

  
George Nguyen  
Primary Examiner

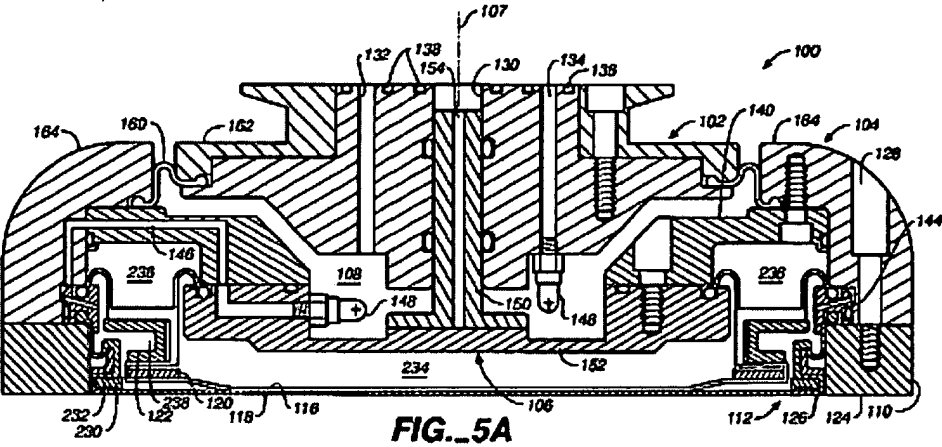
### EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

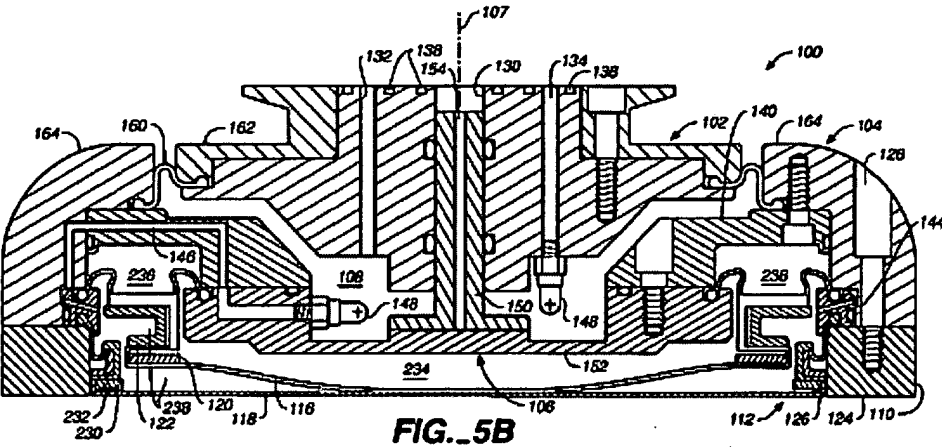
The application has been amended as follows:

In the specification, page 1, line 3, after "09/903,226" inserted "U.S. Patent No. 6,722,965".

2. The following is an examiner's statement of reasons for allowance: the specific limitations of "a flexible membrane ... joined to a central section of the outer membrane portion" in the combination as claimed in claim 1, and "providing a carrier structure ... and the carrier structure" in the combination as claimed in claim 6 are not anticipated nor made obvious by the prior art of record in the examiner's opinion. For example, with reference to Figures 2-3, Zuniga'6,422,927 discloses a substrate backing assembly 112 includes a flexible internal membrane 116, a flexible external membrane 118, an internal support structure 120, an external support structure 230, an internal spacer ring 122, and external spacer rings 232. The annular volume between base assembly 104 and internal membrane 116 that is sealed by inner flap 204 and outer flap 206 defines a pressurizable floating upper chamber 236. The pressure in floating upper chamber will control a contact area of internal membrane 116 against a top surface of external membrane 118.



**FIG. 5A**



**FIG. 5B**

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about carousel axis 64. Three of the carrier head systems position substrates over the polishing stations, and one of the carrier head systems receives a substrate from and delivers the substrate to the transfer station. The carousel motor may orbit the carrier head systems, and the substrates attached thereto, about the carousel axis between the polishing stations and the transfer station.

Each carrier head system 70 includes a polishing or carrier head 100. Each carrier head 100 independently rotates about its own axis, and independently laterally oscillates in a radial slot 72 formed in carousel support plate 66. A carrier drive shaft 74 extends through slot 72 to connect a carrier head rotation motor 76 (shown by the removal of one-quarter of a carousel cover 68) to carrier head 100. There is one carrier drive shaft and motor for each head. Each motor and drive shaft may be supported on a slider (not shown) which can be linearly driven along the slot by a radial drive motor to laterally oscillate the carrier head.

During actual polishing, three of the carrier heads are positioned at and above the three polishing stations. Each carrier head 100 lowers a substrate into contact with polishing pad 32. The carrier head holds the substrate in position against the polishing pad and distributes a force across the back surface of the substrate. The carrier head also transfers torque from the drive shaft to the substrate.

Referring to FIG. 2, carrier head 100 includes a housing 102, a base assembly 104, a gimbal mechanism 106 (which may be considered part of the base assembly), a loading chamber 108, a retaining ring 110, and a substrate backing assembly 112 which includes three pressurizable chambers, such as a floating upper chamber 236, a floating lower chamber 234, and an outer chamber 238. A description of a similar carrier head may be found in U.S. application Ser. No. 08/861,260 by Zuniga, et al., filed May 21, 1997, entitled A CARRIER HEAD WITH A FLEXIBLE MEMBRANE FOR A CHEMICAL MECHANICAL POLISHING SYSTEM, and assigned to the assignee of the present invention, the entire disclosure of which is incorporated herein by reference.

The housing 102 can be connected to drive shaft 74 to rotate therewith during polishing about an axis of rotation 107 which is substantially perpendicular to the surface of the polishing pad during polishing. Housing 102 may be generally circular in shape to correspond to the circular configuration of the substrate to be polished. A vertical bore 130 may be formed through the housing, and three additional passages (only two passages 132, 134 are illustrated in FIG. 2) may extend through the housing for pneumatic control of the carrier head. O-rings 138 may be used to form fluid-tight seals between the passages through the housing and passages through the drive shaft.

The base assembly 104 is a vertically movable assembly located beneath housing 102. The base assembly 104 includes a generally rigid annular body 140, an outer clamp ring 164, gimbal mechanism 106, and a lower clamp ring 144. A passage 146 may extend through the body of the gimbal mechanism, the annular body, and the clamp ring, and two fixtures 148 may provide attachment points to connect a flexible tube between housing 102 and base assembly 104 to fluidly couple passage 134 to one of the chambers in substrate backing assembly 112, e.g., chamber 238. A second passage (not shown) may extend through annular body 140, and two fixtures (also not shown) may provide attachment points to connect a flexible tube between housing 102 and base assembly 104 to fluidly couple the unillustrated passage in the housing to a second chamber in

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The gimbal mechanism 106 permits the base assembly to pivot with respect to housing 102 so that the retaining ring may remain substantially parallel with the surface of the polishing pad. Gimbal mechanism 106 includes a gimbal rod 150 which fits into vertical bore 130 and a flexure ring 152 which is secured to annular body 140. Gimbal rod 150 may slide vertically along bore 130 to provide vertical motion of base assembly 104, but it prevents any lateral motion of base assembly 104 with respect to housing 102 and reduces moment generated by the lateral force of the substrate against the retaining ring. Gimbal rod 150 may include a passage 154 that extends the length of the gimbal rod to fluidly couple bore 130 to a third chamber in substrate backing assembly 112, e.g., chamber 234.

The loading chamber 108 is located between housing 102 and base assembly 104 to apply a load, i.e., a downward pressure or weight, to base assembly 104. The vertical position of base assembly 104 relative to polishing pad 32 is also controlled by loading chamber 108. An inner edge of a generally ring-shaped rolling diaphragm 160 may be clamped to housing 102 by an inner clamp ring 162. An outer edge of rolling diaphragm 160 may be clamped to base assembly 104 by outer clamp ring 164. Thus, rolling diaphragm 160 seals the space between housing 102 and base assembly 104 to define loading chamber 108. A first pump (not shown) may be fluidly connected to loading chamber 108 by passage 132 to control the pressure in the loading chamber and the vertical position of base assembly 104.

The retaining ring 110 may be a generally annular ring secured at the outer edge of base assembly 104, e.g., by bolts 128. When fluid is pumped into loading chamber 108 and base assembly 104 is pushed downwardly, retaining ring 110 is also pushed downwardly to apply a load to polishing pad 32. A bottom surface 124 of retaining ring 110 may be substantially flat, or it may have a plurality of channels to facilitate transport of slurry from outside the retaining ring to the substrate. An inner surface 126 of retaining ring 110 engages the substrate to prevent it from escaping from beneath the carrier head.

Referring to FIGS. 2 and 3, substrate backing assembly 112 includes a flexible internal membrane 116, a flexible external membrane 118, an internal support structure 120, an external support structure 230, an internal spacer ring 122, and an external spacer ring 232. Support structures 120 and 230 and spacer rings 122 and 232 may be "free-floating", i.e., not secured to the rest of the carrier head, and may be held in place by the internal and external flexible membranes.

The flexible internal membrane 116 includes a central portion 200 which will apply pressure to the substrate in a controllable area, a relatively thick annular portion 202 with an "L-shaped" cross-section, an annular inner flap 204 that extends from the corner of L-shaped portion 202, an annular outer flap 206 that extends from the outer rim of L-shaped portion 202, and a perimeter portion 208 that extends around internal support structure 120 to connect L-shaped portion 202 and central portion 200. The rim of inner flap 204 is clamped between flexure ring 152 and annular body 140, whereas the rim of outer flap 206 is clamped between outer clamp ring 164 and lower clamp ring 144. The volume between base assembly 104 and internal membrane 116 that is sealed by inner flap 204 provides a pressurizable floating lower chamber 234. The annular volume between base assembly 104 and internal membrane 116 that is sealed by inner flap 204 and outer flap 206 defines a pressurizable floating upper chamber 236. A second pump (not shown)

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e.g., a gas, such as air, into or out of the floating upper chamber 236. A third pump (not shown) may be connected to bore 130 to direct a fluid, e.g., a gas, such as air, into or out of floating lower chamber 234. The second pump controls the pressure in the upper chamber and the vertical position of the lower chamber, and the third pump controls the pressure in the lower chamber. As explained in greater detail below, the pressure in floating upper chamber 236 will control a contact area of internal membrane 116 against a top surface of external membrane 118. Thus, the second pump controls the area of the substrate against which pressure is applied, i.e., the loading area, whereas the third pump controls the downward force on the substrate in the loading area.

The external membrane 118 includes a central portion 210 that extends below external support structure 230 to provide a mounting surface to engage the substrate, and a perimeter portion 212 that extends in a serpentine path between external support structure 230 and external spacer ring 232 to be secured to the base assembly. For example, an edge of the external membrane may be clamped between lower clamp ring 144 and retaining ring 110. The sealed volume between internal membrane 116 and external membrane 118 defines a pressurizable outer chamber 238. Thus, outer chamber 238 can actually extend below the lower chamber 234. A fourth pump (not shown) may be connected to passage 134 to direct fluid, e.g., a gas, such as air, into or out of outer chamber 238. The fourth pump controls the pressure in outer chamber 238.

The internal support structure 120 may be a generally rigid annular washer-shaped body located inside floating lower chamber 234 to maintain the desired shape of internal membrane 116. Alternatively, the internal support structure may be a disk-shaped body with a plurality of apertures therethrough. The disk-shaped support structure would provide a backing surface to prevent the substrate from being damaged due to warping.

The internal spacer ring 122 is a generally rigid annular body which may have a "C-shaped" cross-section. The internal spacer ring may include a cylindrical portion 190, an annular upper flange 192, and an annular lower flange 194. The internal spacer ring 122 may be located in outer chamber 238 above internal support structure 120. The annular lower flange 194 can be supported by the internal support structure, whereas annular upper flange 192 can extend over external support structure 230 and external spacer ring 232.

The internal membrane 116 is formed of a flexible and elastic material, such as an elastomer, an elastomer coated fabric, or a thermal plastic elastomer (TPE), e.g., HYTREL™ available from DuPont of Newark, Del., or a combination of these materials. Preferably, internal membrane 116 is somewhat less flexible than external membrane 118. As discussed above, a controllable region of central portion 200 of internal membrane 116 can contact and apply a downward load to an upper surface of external membrane 118. The load is transferred through the external membrane to the substrate in the loading area. The bottom surface of central portion 200 of internal membrane 116 may be textured, e.g., with small grooves, to ensure that fluid can flow between the internal and external membranes when they are in contact. The perimeter portion 208 of the internal membrane extends upwardly around an outer surface 180 of internal support structure 120, and inwardly between lower flange 194 of internal spacer ring 122 and an upper surface 182 of the internal support structure to connect to the lower edge of L-shaped portion 202. The L-shaped portion 202 of

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the internal membrane extends inside cylindrical portion 190 and over annular upper flange 192 of the internal spacer ring 122.

The external support structure 230 is located inside outer chamber 238 between internal membrane 116 and external membrane 118 to maintain the desired shape of external membrane 118 and to seal the external membrane against the substrate during vacuum-chucking. Specifically, external support structure 230 may have a generally rigid ring-shaped portion 170 with an annular projection 172 that extends downwardly from the rim of the ring-shaped portion. Alternatively, projection 172 may be positioned to contact a top surface of the external membrane to preferentially apply pressure to selected areas of the substrate, as discussed in U.S. application Ser. No. 08/907,810, by Steven M. Zuniga, et al., filed Aug. 8, 1997, entitled A CARRIER HEAD WITH LOCAL PRESSURE CONTROL FOR A CHEMICAL MECHANICAL POLISHING APPARATUS, and assigned to the assignee of the present invention, the entire disclosure of which is incorporated herein by reference. The projection 172 may be formed by adhesively attaching a layer of compressible material to a lower surface of ring-shaped portion 170.

The external spacer ring 232 is a generally annular member positioned between retaining ring 110 and external membrane 118. Specifically, external spacer ring 232 may be located above external support structure 230. External spacer ring 232 includes a cylindrical portion 184 and a flange portion 186 which extends outwardly toward inner surface 126 of retaining ring 110 to maintain the lateral position of the external spacer ring.

External membrane 118 is a generally circular sheet formed of a flexible and elastic material, such as chloroprene or ethylene propylene rubber, or silicone. As noted, central portion 210 of the external membrane defines a mounting surface for the substrate, whereas perimeter portion 212 extends in a serpentine fashion between external support structure 230 and external spacer ring 232 to be clamped between base assembly 104 and retaining ring 110. Specifically, perimeter portion 212 extends upwardly around an outer surface 174 of external support structure 230, inwardly between flange portion of external spacer ring 232 and an upper surface 176 of external support structure 230, upwardly around cylindrical portion 184 of external spacer ring 232, and then outwardly to a rim portion 214 which is clamped between lower clamp ring 144 and retaining ring 110 to form a fluid-tight seal. A "free span" portion 216 of the external membrane extends between rim portion 214 and the outer diameter of the upper surface of external spacer ring 232. The external membrane 118 may also include a thick portion 218 that extends upwardly between internal spacer ring 122 and external spacer ring 232. The external membrane may be pre-molded into a serpentine shape.

In operation, fluid is pumped into or out of floating lower chamber 234 to control the downward pressure of internal membrane 116 against external membrane 118 and thus against the substrate, and fluid is pumped into or out of floating upper chamber 236 to control the contact area of internal membrane 116 against external membrane 118. The ability of carrier head 100 to control both the loading area and the pressure applied to the substrate will be explained with reference to the schematic diagrams of FIGS. 4A and 4B. Referring to FIG. 4A, a hypothetical and highly schematic polisher 300 includes a "free-floating" flexible membrane 302 that defines a pressurizable chamber 306. Assuming that no external pressures are applied to flexible membrane 302, it will be generally spherical and have an

However, the prior art of record fails to provide or suggest the specific limitations of "a flexible membrane ... joined to a central section of the outer membrane portion" in the combination as claimed in claim 1, and "providing a carrier structure ... and the carrier structure" in the combination as claimed in claim 6.

3. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to George Nguyen whose telephone number is 571-272-4491. The examiner can normally be reached on Monday-Friday/630AM-300PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Joseph Hail can be reached on 571-272-4485. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

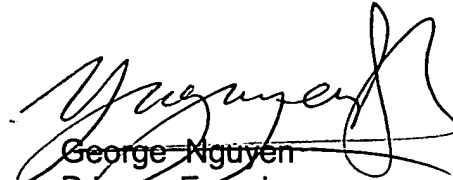
Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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GN – February 26, 2005